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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/816,015
Filing Date: March 31, 2004
Appellant(s): BERNARD DE MAN ET AL.

Jean K. Testa
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed July 9, 2007, appealing from the Office action mailed February 7, 2007.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is incorrect. A correct statement of the status of the claims is as follows:

This appeal involves claims 1, 3-21, 23-33, 35-37, 39-41, and 43-47. Claims 35 and 45-47 have been amended subsequent to the final rejection.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is incorrect.

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

Claims 37 and 45-47 contain(s) substantial errors as presented in the Appendix to the brief. Accordingly, claims 37 and 45-47 are correctly written in the Appendix to the Examiner's Answer.

(8) Evidence Relied Upon

US 2004/0213378 A1	Zhou et al.	10-2004
US 6504892 B1	Ning	01-2003
US 2002/0094064 A1	Zhou et al.	07-2002
US 2002/0085674 A1	Price et al.	07-2002
US 5225980	Hsieh et al.	07-1993

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. Claims 45 and 47 are rejected under 35 U.S.C. 102(e) as being anticipated by Zhou et al. (US 2004/0213378).

Zhou et al. discloses a system and method (fig. 8) comprising one or more distributed X-ray sources (fig. 8, #802) substantially surrounding an imaging volume (fig. 8, on #804) and configured to generate X-ray radiation (paragraph 71, line 5) towards the imaging volume, wherein the one or more distributed X-ray sources comprise at least one stationary distributed source positioned about a scanner aperture (paragraph 71, lines 8-10), one or more detectors (fig. 8, #806) for receiving the X-ray radiation after attenuation in the imaging volume (fig. 8, on #804) and processing corresponding signals to produce measurement volumetric data (paragraph 64), wherein the one or more detectors comprise at least one distributed detector configured to rotate around the scanner aperture (paragraph 71, lines 10-12), and a source controller for triggering one or more emitters in the one or more distributed X-ray sources (paragraph 52) at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors (paragraph 53).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

> having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1, 5, 8-10, 12, 14, 15, 17, 18, 23-27, 29, 30, 35, 36, 41, 43, and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhou et al. in view of Ning (US 6504892).

3. Regarding claims 1 and 41, Zhou et al. discloses a system and method (fig. 8) comprising one or more distributed X-ray sources (fig. 8, #802) substantially surrounding an imaging volume (fig. 8, on #804) and configured to generate X-ray radiation (paragraph 71, line 5) towards the imaging volume, one or more detectors (fig. 8, #806) for receiving the X-ray radiation after attenuation in the imaging volume (fig. 8, on #804) and processing corresponding signals to produce measurement volumetric data (paragraph 64), and a source controller for triggering one or more emitters in the one or more distributed X-ray sources (paragraph 52) at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors (paragraph 53), wherein the one or more distributed X-ray sources and/or the one or more detectors are arranged about a scanner aperture (fig. 8, aperture of #802 and 806) such that the one or more distributed X-ray sources are around the scanner aperture in relation to the imaging volume during an imaging sequence (paragraph 71).

However, Zhou et al. fails to disclose arranging about a scanner aperture for rotation around the scanner aperture in relation to an imaging volume during an imaging sequence.

Ning teaches arranging about a scanner aperture for rotation (col. 4, lines 35-52, “arc”) around the scanner aperture in relation to an imaging volume (fig. 7, at P) during an imaging sequence.

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to modify the system and method of Zhou et al. with the rotation of Ning, since one would have been motivated to make such a modification for more accurate reconstruction (col. 3, lines 45-49) as implied from Ning.

4. Regarding claims 15 and 44, Zhou et al. further discloses wherein the one or more distributed X-ray sources comprise at least one distributed source configured to rotate around the scanner aperture (paragraph 71, lines 10-12) and the one or more detectors comprise at least one stationary and distributed detector positioned about the scanner aperture (paragraph 71, lines 8-10).

5. Regarding claims 5 and 17, Zhou et al. further discloses wherein the one or more distributed X-ray sources comprise one or more one-dimensional arrays of source elements (paragraph 71, lines 4-5, which together form the circular x-ray source) extending substantially around the aperture.

6. Regarding claims 8 and 18, Zhou et al. further discloses wherein the one or more distributed X-ray sources comprise one or more one-dimensional arrays of source elements extending around at least a portion of the aperture (paragraph 71, lines 4-5).

7. Regarding claims 9, 23, and 24, Zhou et al. further discloses wherein the one or more detectors comprise one or more two-dimensional arrays of detector elements (fig. 8, #806) extending around at least a portion of the aperture or substantially around the aperture.

8. Regarding claims 10, 25, and 26, Zhou et al. further discloses wherein the one or more detectors comprise one or more one-dimensional arrays of detector elements (fig. 8, which together form the two-dimensional array of #806) extending around at least a portion of the aperture or substantially around the aperture.

9. Regarding claim 12, Zhou et al. further discloses wherein the one or more distributed X-ray sources comprise a plurality of independently addressable (paragraph 3, line 6) source elements in one or more arrays.

10. Regarding claim 14, Zhou et al. further discloses wherein the one or more distributed X-ray sources comprise addressable emission devices and the emission devices comprise thermionic emitters, cold-cathode emitters, carbon-based emitters (paragraph 3, lines 3-4), photo emitters, ferroelectric emitters, laser diodes, or monolithic semiconductors.

11. Regarding claims 27 and 43, Ning further teaches an X-ray source (fig. 7, #710) configured to rotate (fig. 7, via #713) around a scanner aperture and a detector (fig. 7, #711) configured to rotate around a scanner aperture.

12. Regarding claim 29, Zhou et al. further discloses wherein the at least one distributed source includes one or more one-dimensional arrays of source elements (fig. 8, #802).

13. Regarding claim 30, Zhou et al. further discloses wherein the one or more one-dimensional arrays of source elements (fig. 8, #802) extend around at least a portion of the aperture.

14. Regarding claims 35 and 36, Zhou et al. further discloses wherein the at least one distributed detector includes one or more two-dimensional or one-dimensional arrays of detector elements (fig. 8, which together form #806) extending around at least a portion of the aperture.

15. Claims 3, 4, 6, 7, 11, 16, 19-21, 28, and 31-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhou et al. ('378) and Ning as applied to claims 1, 5, 15, 17, 18, 27, 30, and 29 above, and further in view of Zhou et al. (US 2002/0094064).

16. Regarding claims 3, 4, and 16, Zhou et al. ('378) as modified above suggests a system as recited above. Zhou et al. ('378) further discloses wherein the one or more distributed X-ray sources comprise arrays (fig. 1) of source elements extending substantially around or around a portion the aperture (paragraph 71, lines 4-6).

However, Zhou et al. ('378) fails to disclose one or more two-dimensional areas.

Zhou et al. ('064) teaches one or more two-dimensional areas (fig. 4, #404).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to further modify the system of Zhou et al. ('378) as modified above with the areas of Zhou et al. ('064), since one would have been motivated to make such a modification for imaging a larger object from different areas and/or angles without having to move the object or the x-ray source (paragraph 25) as shown by Zhou et al. ('064), which would reduce wear on a system.

17. Regarding claims 6 and 19, Zhou et al. ('378) further discloses one one-dimensional array of source elements extending substantially around the aperture (paragraph 71, lines 4-6, circular x-ray source). Zhou et al. ('064) further teaches one or more lines (fig. 4, lines from inner to outer edges of #420).

18. Regarding claims 7, 11, and 20, Zhou et al. ('064) further teaches two or more one one-dimensional areas extending substantially around (paragraph 38, lines 11-13), and one or more lines (fig. 4, lines from inner to outer edges of #420).

19. Regarding claim 21, Zhou et al. ('064) further teaches wherein at least one line (fig. 4, line from inner to outer edges of #420) extends at least along a Z-direction (fig. 4, direction along long axis of #418).

20. Regarding claim 28, Zhou et al. ('378) as modified above suggests a system as recited above. Zhou et al. ('378) further discloses wherein the one or more distributed X-ray sources

include arrays (fig. 1) of source elements extending substantially around or around a portion of the aperture (paragraph 71, lines 4-6).

However, Zhou et al. ('378) fails to disclose one or more two-dimensional areas.

Zhou et al. ('064) teaches one or more two-dimensional areas (fig. 4, #404).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to further modify the system of Zhou et al. ('378) as modified above with the areas of Zhou et al. ('064), since one would have been motivated to make such a modification for imaging a larger object from different areas and/or angles without having to substantially move the object or the x-ray source (paragraph 25) as shown by Zhou et al. ('064), which would reduce wear on a system.

21. Regarding claims 31 and 33, Zhou et al. ('378) further discloses a one-dimensional array of source elements (paragraph 71, lines 4-6). Zhou et al. ('064) further teaches at least one line (fig. 4, lines from inner to outer edges of #420) extending at least along a Z-direction (fig. 4, direction along long axis of #418).

22. Regarding claim 32, Zhou et al. ('064) further teaches two or more one-dimensional areas (fig. 4, along the inner and outer edges of #420) and one or more lines (fig. 4, lines from inner to outer edges of #420).

23. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhou et al. ('378) and Ning as applied to claim 1 above, and further in view of Price et al. (US 2002/0085674).

Zhou et al. as modified above suggests a system as recited above.

However, Zhou et al. fails to disclose a cold cathode emitter housed in a vacuum housing and an anode disposed in a vacuum housing and spaced apart from the cold cathode emitter.

Price et al. teaches a cold cathode emitter housed in a vacuum housing (abstract, lines 2-3) and an anode disposed in a vacuum housing and spaced apart from the cold cathode emitter (abstract, lines 3-4).

It would have been obvious, to one having ordinary skill in the art at the time of the invention was made, to further modify the system of Zhou et al. as modified above with the cathode and anode of Price et al., since one would have been motivated to make such a modification for reducing the complexity of a scanning system (paragraph 6) as shown by Price et al.

24. Claims 37, 39, 40, and 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhou et al. ('378) in view of Ning and Hsieh et al. (US 5225980).

25. Regarding claim 37, Zhou et al. discloses a system comprising one or more distributed X-ray sources (fig. 8, #802) substantially surrounding an imaging volume (fig. 8, on #804) and configured to emanate X-ray radiation (paragraph 71, line 5), a necessary control circuit (paragraph 28, lines 1-6, for controlling the sequence or pattern) operably coupled to the one or more distributed X-ray sources, one or more detectors (fig. 8, #806) for receiving the X-ray radiation after attenuation in the imaging volume (fig. 8, on #804), a source controller for triggering one or more emitters in the one or more distributed X-ray sources (paragraph 52) at

each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors (paragraph 53), displacing at least one of the one or more distributed X-ray sources and the one or more detectors (paragraph 71, lines 10-12), a processing circuit operably coupled to the one or more detectors configured to receive a plurality of projection images (paragraph 33, lines 8-11) and to form one or more reconstructed slices representative of the volume being imaged (paragraph 66), wherein the one or more distributed X-ray sources are arranged about a scanner aperture such that the one or more distributed X-ray sources are about a scanner aperture (paragraph 71, lines 10-12) in relation to the imaging volume during an imaging sequence.

However, Zhou et al. fails to disclose a motor controller for rotating about a scanner aperture and an operator workstation operably coupled to a processing circuit configured to display one or more reconstructed slices.

Ning teaches a motor controller (fig. 7, #713 and 715) for rotating about a scanner aperture. Hsieh et al. teaches an operator workstation (fig. 2, #60 and 64) operably coupled to a processing circuit configured to display one or more reconstructed slices (col. 6, lines 16-22).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to modify the system of Zhou et al. with the motor controller for rotation of Ning, since one would have been motivated to make such a modification for more easily moving components (fig. 7, #713) and for more accurate reconstruction (col. 3, lines 45-49) as implied from Ning.

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to modify the system of Zhou et al. with the display of Hsieh et al., since

one would have been motivated to make such a modification for more easily interpreting image data.

26. Regarding claim 39, Ning further teaches an X-ray source (fig. 7, #710) configured to rotate (fig. 7, via #713) around a scanner aperture and a detector (fig. 7, #711) configured to rotate around a scanner aperture.

27. Regarding claim 40, Zhou et al. further discloses wherein the one or more distributed X-ray sources comprise at least one distributed source configured to rotate around the scanner aperture (paragraph 71, lines 10-12) and the one or more detectors comprise at least one stationary and distributed detector positioned about the scanner aperture (paragraph 71, lines 8-10).

28. Regarding claim 46, Zhou et al. discloses a system comprising one or more distributed X-ray sources (fig. 8, #802) substantially surrounding an imaging volume (fig. 8, on #804) and configured to emanate X-ray radiation (paragraph 71, line 5), wherein the one or more distributed X-ray sources comprise at least one stationary distributed source positioned about a scanner aperture (paragraph 71, lines 8-10), a necessary control circuit (paragraph 28, lines 1-6, for controlling the sequence or pattern) operably coupled to the one or more distributed X-ray sources, one or more detectors (fig. 8, #806) for receiving the X-ray radiation after attenuation in the imaging volume (fig. 8, on #804), wherein the one or more detectors comprise at least one distributed detector configured to rotate around a scanner aperture (paragraph 71, lines 10-12), a

source controller for triggering one or more emitters in the one or more distributed X-ray sources (paragraph 52) at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors (paragraph 53), displacing at least one of the one or more distributed X-ray sources and the one or more detectors (paragraph 71, lines 10-12), and a processing circuit operably coupled to the one or more detectors configured to receive a plurality of projection images (paragraph 33, lines 8-11) and to form one or more reconstructed slices representative of the volume being imaged (paragraph 66).

However, Zhou et al. fails to disclose a motor controller and an operator workstation operably coupled to a processing circuit configured to display one or more reconstructed slices.

Ning teaches a motor controller (fig. 7, #713 and 715). Hsieh et al. teaches an operator workstation (fig. 2, #60 and 64) operably coupled to a processing circuit configured to display one or more reconstructed slices (col. 6, lines 16-22).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to modify the system of Zhou et al. with the motor controller of Ning, since one would have been motivated to make such a modification for more easily moving components (fig. 7, #713) as implied from Ning.

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to modify the system of Zhou et al. with the display of Hsieh et al., since one would have been motivated to make such a modification for more easily interpreting image data.

(10) Response to Argument

Regarding the first ground of rejection, in response to Appellant's argument that the references fail to show certain features of Appellant's invention, it is noted that the features upon which Appellant relies (i.e., rotation about the scanner aperture for the purpose of imaging the object) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

In this case, Zhou et al. ('378) does disclose rotation around the scanner aperture (paragraph 71, lines 10-12) to the extent as claimed. Therefore, the slight rotation of Zhou et al. ('378) meets the limitations of the claims.

Regarding the second ground of rejection, in response to Appellant's argument that the imaging systems and techniques of Zhou et al. ('378) and Ning cannot be combined (see pg. 14 of the appeal brief, second full paragraph), the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). Furthermore, in response to Appellant's arguments against the references individually (see pg. 14 of the appeal brief, last full paragraph), one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642

F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

In this case, Zhou et al. ('378) discloses one or more distributed X-ray sources (fig. 8, #802) substantially surrounding an imaging volume (fig. 8, on #804). Ning teaches source rotation around the scanner aperture in relation to the imaging volume during an imaging sequence (col. 4, lines 35-52, "arc"). Therefore, the combination of references suggests one or more distributed X-ray sources substantially surrounding an imaging volume (Zhou et al. ('378)) with source rotation around the scanner aperture in relation to the imaging volume during an imaging sequence (Ning).

Appellant further argues that there is no teaching or motivation in Ning that would render it combinable with the stationary system of Zhou et al. ('378). The Examiner disagrees. Zhou et al. ('378) discloses a stationary system for imaging in a circular arc (fig. 8). Ning teaches a system for imaging in a circular arc and an arc sub-orbit (fig. 4a). Since Ning teaches the incorporation of rotation (i.e., arc sub-orbits) to circular arc imaging, such a teaching would apply to Zhou et al. ('378), which has circular arc imaging. Therefore, the teachings of Ning are combinable with the stationary system (i.e., circular arc imaging) of Zhou et al. ('378), which one would be motivated to make for more accurate reconstruction (col. 3, lines 45-49) as implied from Ning.

Appellant also argues that combining Zhou et al. ('378) with Ning would completely negate the entire objective of Zhou et al. ('378). The Examiner disagrees. Using the stationary arrangement of Zhou et al. ('378) for imaging along a circular arc direction, the teachings of Ning would make it obvious to rotate the arrangement of Zhou et al. ('378) along an arc sub-orbit

(fig. 4a). The arrangement of Zhou et al. ('378) would still remain stationary along the circular arc direction even during the sub-orbit arc rotation, thus retaining the objective of Zhou et al. ('378) for reducing rotational components in comparison to the rotation of components along the circular arc direction (fig. 4a) in Ning.

Regarding the third ground of rejection, Appellant further argues that the Zhou et al. ('064) fails to teach two-dimensional arrays of source elements. The Examiner disagrees. Although, Appellant refers to the target structure (fig. 4, #404), which is part of the X-ray source showing the concept of using two-dimensional areas, that target structure is not the two-dimensional array of source elements in Zhou et al. ('064). The electron emitters (fig. 4, #402) of Zhou et al. ('064) are the two-dimensional array of source elements. Therefore, such a teaching in Zhou et al. ('064) reads on the corresponding claim limitations.

Regarding the fourth and fifth grounds of rejection, Appellant did not separately argue the patentability of claims 13, 37, 39, 40, and 46. Therefore, these claims stand rejected for the reasons set forth in the final Office action mailed February 7, 2007.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Chih-Cheng Glen Kao
Examiner
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Conferees:

Ricky Mack

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SUPERVISORY PATENT EXAMINER

Appendix to the Examiner's Answer

37. An X-ray imaging system for scanning a volume to be imaged, the system comprising:

one or more distributed X-ray sources substantially surrounding an imaging volume and configured to emanate X-ray radiation;

a control circuit operably coupled to the distributed X-ray sources;

one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume;

a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors;

a motor controller configured to displace at least one of the one or more distributed X-ray sources, and the one or more detectors;

a processing circuit operably coupled to the one or more detectors configured to receive a plurality of projection images and to form one or more reconstructed slices representative of the volume being imaged; and

an operator workstation operably coupled to the processing circuit configured to display the one or more reconstructed slices,

wherein the one or more distributed X-ray sources are arranged about a scanner aperture such that the one or more distributed X-ray sources rotate about a scanner aperture in relation to the imaging volume during an imaging sequence.

45. An imaging system comprising:

one or more distributed X-ray sources substantially surrounding an imaging volume and configured to generate X-ray radiation towards the imaging volume, wherein the one or more distributed X-ray sources comprise at least one stationary distributed source positioned about a scanner aperture;

one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume and processing corresponding signals to produce measurement volumetric data, wherein the one or more detectors comprise at least one distributed detector configured to rotate around the scanner aperture.; and

a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors.

46. An X-ray imaging system for scanning a volume to be imaged, the system comprising:

one or more distributed X-ray sources substantially surrounding an imaging volume and configured to emanate an X-ray radiation, wherein the one or more distributed X-ray sources comprises at least one stationary distributed source positioned about a scanner aperture;

a control circuit operably coupled to the distributed X-ray sources;

one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume, wherein the one or more detectors comprise at least one distributed detector configured to rotate around the scanner aperture.;

a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors;

a motor controller configured to displace at least one of the distributed X-ray sources; and the detectors;

a processing circuit operably coupled to the detectors configured to receive the plurality of projection images and to form one or more reconstructed slices representative of the volume being imaged; and

an operator workstation operably coupled to the processing circuit configured to display the one or more reconstructed slices.

47. A method of scanning a volume to be imaged, the method comprising:

providing at least one stationary distributed X-ray source positioned substantially surrounding an imaging volume for generating X-ray radiation towards the imaging volume;

providing at least one distributed detector configured to rotate around a scanner aperture and configured for receiving the X-ray radiation after attenuation; and

providing a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors.